UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/052,688	03/31/1998	LAWRENCE A. CLEVENGER	98P7476US	9416

7590 07/01/2003

SIEMENS CORPORATION
INTELLECTUAL PROPERTY DEPARTMENT
186 WOOD AVENUE SOUTH
ISELIN, NJ 08830

EXAMINER
PERALTA, GINETTE

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 07/01/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/052,688	CLEVENGER ET AL.	
	Examiner	Art Unit	
	Ginette Peralta	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 May 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,7-15 and 28-30* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-15,28-30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-5, 7-15, and 28-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Teong (U. S. Pat. 5,693,563) in view of Hegde et al. (U. S. Pat. 6,136,682), as previously applied.

Teong teaches in Fig. 7 an integrated circuit comprising a dielectric layer formed over a substrate, a first damascene structure in the dielectric layer, the first damascene structure comprising a bottom surface and first and second sidewalls, a first conductor (18) located in the damascene structure, the conductor comprising a conductive material, a first liner layer (7) lining the bottom surface and sidewalls of the first damascene structure and encapsulating (11) the first conductor (18) by contacting a top surface of the first conductor, the liner layer comprising titanium nitride, a second damascene structure in the dielectric layer, the second damascene structure comprising a bottom surface and second sidewalls and disposed above the first damascene structure, a second conductor (28) located in the damascene structure, the conductor

comprising a conductive material, a second liner layer (17) lining the bottom surface and sidewalls of the second damascene structure, and wherein the second liner layer is in contact with the first liner layer, wherein the material of the liner is titanium nitride, wherein the liner layer has a thickness between about 500 and 2000 Å, the structure further comprising a subliner (4,14) of titanium with a thickness between about 500 and 1500 Å, wherein the conductive material comprises copper, wherein the cavity that is filled with the conductor has a depth of between 2000 and 6000Å.

With respect to the limitation of "N_2/H_2 plasma treated titanium nitride" is directed to a process for forming an amorphous titanium nitride layer. "Product by process" limitations in claims drawn to structure are directed to the product, and not the process by which the product was obtained.

With respect to claims 8 and 15, since applicants failed to show a critical nature of the claimed thickness pertaining unexpected results, further noting that it is well known and desirable in the art that to some extent scaling for higher density requires thinner device layers, it would have been obvious to one of ordinary skill in the art to vary the thickness of the titanium nitride layer and the aluminum layer.

Teong teaches all the limitations in the claims with the exception of disclosing a liner layer of an amorphous character that would impart a random grain orientation to the conductive material.

Hegde et al. teaches an integrated circuit comprising a dielectric layer formed over a substrate, a first damascene structure in the dielectric layer, the first damascene

structure comprising a bottom surface and first and second sidewalls, a first conductor located in the damascene structure, a first liner layer lining the bottom surface and sidewalls of the first damascene structure, the liner layer being amorphous and thus imparting a random grain orientation in the conductive material of the first conductor to improve electromigration lifetime of the first conductor (col. 3, ll. 1-24), wherein the liner layer comprises tantalum nitride and titanium nitride, and the thickness of the liner layer is between about 0 to 400Å, and the structure comprising a subliner.

Thus, it would have been obvious to one of ordinary skill in the art to use an amorphous titanium nitride layer in the invention of Teong et al. for the disclosed intended purpose of Hegde et al. of obtaining an improved copper barrier layer.

Furthermore, it would have been within the scope of one of ordinary skill in the art to form the liner layer of the second conductor to encapsulate the conductor as Teong et al. teaches the feature in the first conductor and the repetition of a previously taught structure is not a patentable feature as it would not yield any unexpected results.

Response to Arguments

3. Applicant's arguments filed 5/5/03 have been fully considered but they are not persuasive.

With regards to applicant's argument that there is nothing in Teong or Hegde et al. that would even remotely suggest to one of ordinary skill in the art a damascene structure comprising a conductor having a random grain orientation, wherein a liner layer imparts a random grain orientation in the conductive material of the conductor it

is noted that Hegde et al. teaches in Col. 3, ll. 1-5, that "due to the presence of the tantalum nitride, the titanium nitride, which usually deposits in a crystalline form, will mimic the amorphous tantalum nitride structure and thus be deposited in an amorphous state which improves barrier properties", thus it is noted that the barrier is improved because of the amorphous state of the layers and not because of the presence of tantalum nitride, furthermore, it is noted that since the liner layer has an amorphous structure, thus a random grain orientation, that the conductive material deposited on this amorphous liner layer will also have the random grain orientation characteristic due to the transfer of the amorphous structure to the deposited layer. Furthermore, it is noted that Hegde et al. discloses that the use of an amorphous barrier layer is beneficial for the intended purpose of improving barrier properties, the benefit of improving the electromigration lifetime of the conductor will be an inherent result of the random grain orientation of the conductor which is a result of the use of the amorphous liner layers.

With regards to applicant's argument that the examiner ignores the fact that electromigration reliability lifetime can depend on the liner/metal stack and the metallization process used, it is noted that Teong as modified by Hegde et al. discloses a damascene structure having a titanium nitride/ tantalum nitride amorphous liner layer on which a conductor which is preferably copper in order to have improved electromigration properties (Teong, col. 1, ll. 10-19), but where it is also taught that aluminum is conventionally used, it is further noted that the combination taught by

Teong as modified by Hegde et al. would result in an improved electromigration lifetime as shown in applicant's specification.

In response to Applicant's argument that the Examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in any sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the invention was made, and does not include knowledge gleaned only from the Applicant's disclosure, such a reconstruction is proper. In re McLaughlin, 443 F.2d 1392; 170 USPQ 209 (CCPA 1971).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ginette Peralta whose telephone number is (703)305-7722. The examiner can normally be reached on Monday to Friday 8:00 AM- 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703)308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703)308-7722 for regular communications and (703)308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

GP
June 26, 2003

SUP[illegible]ER
TECHNOLOGY CENTER 2800